

Fiber-Based Electro-Optic Field-Mapping System

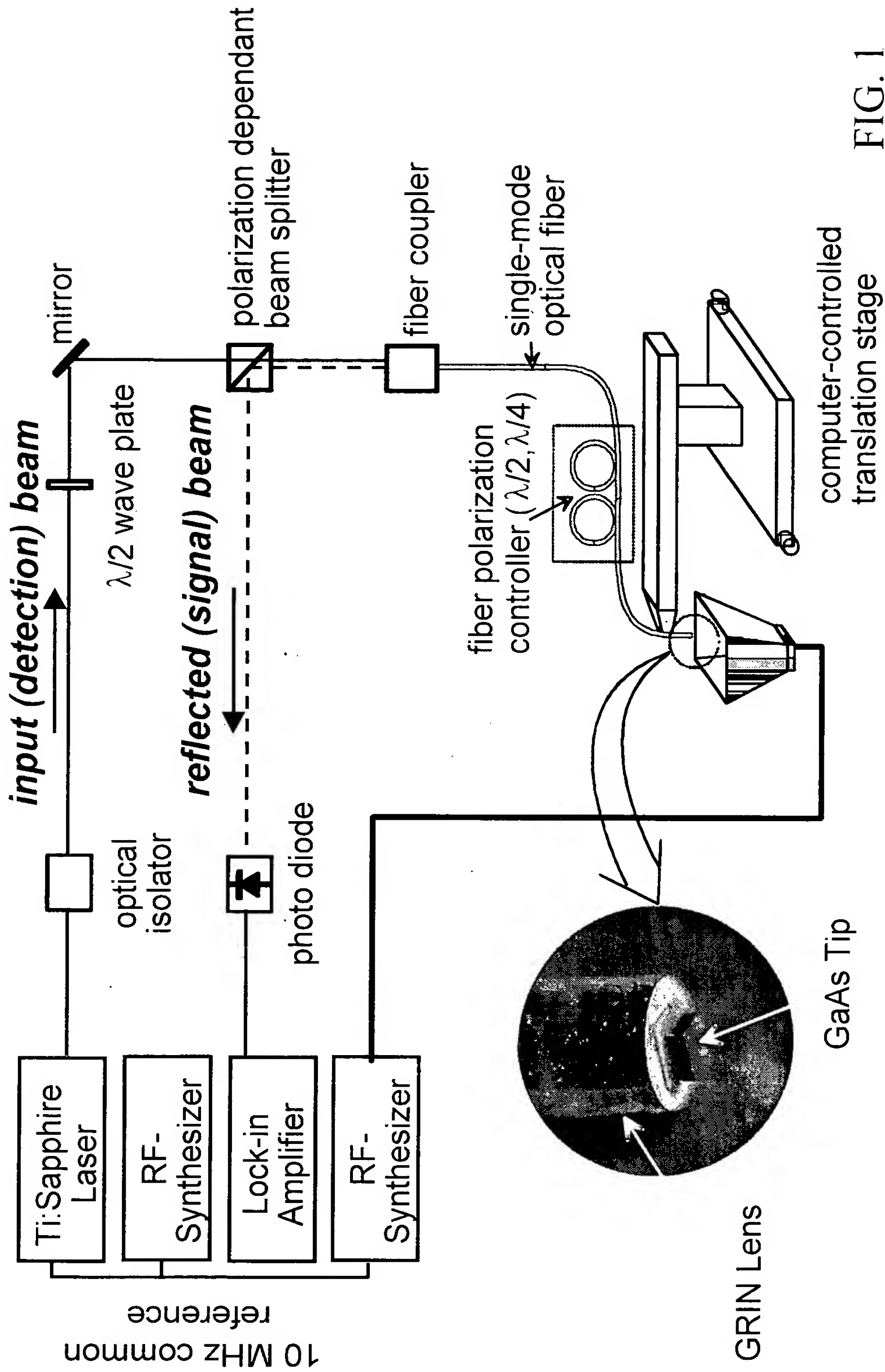


FIG. 1

Fiber-Based Electro-Optic Field-Mapping System

Polarization Control

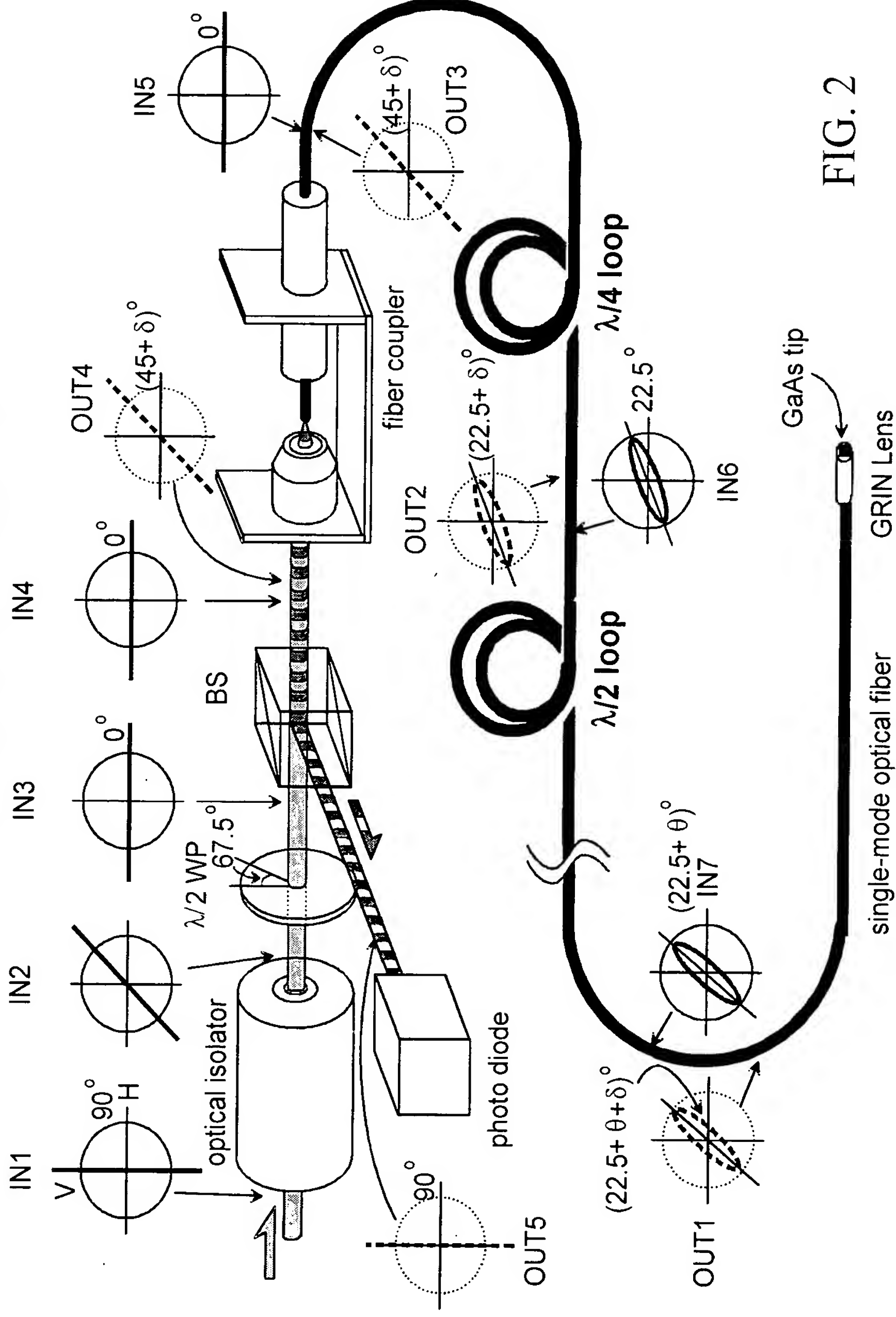
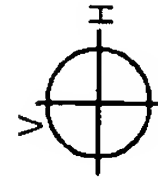
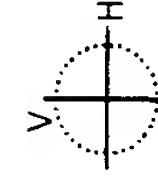


FIG. 2



detection (input) beam polarization (w.r.t. horizontal axis)



signal (reflected) beam (w.r.t. horizontal axis)

(w.r.t. horizontal axis)

Fiber-Based Electro-Optic Sampling System

GRIN Lens

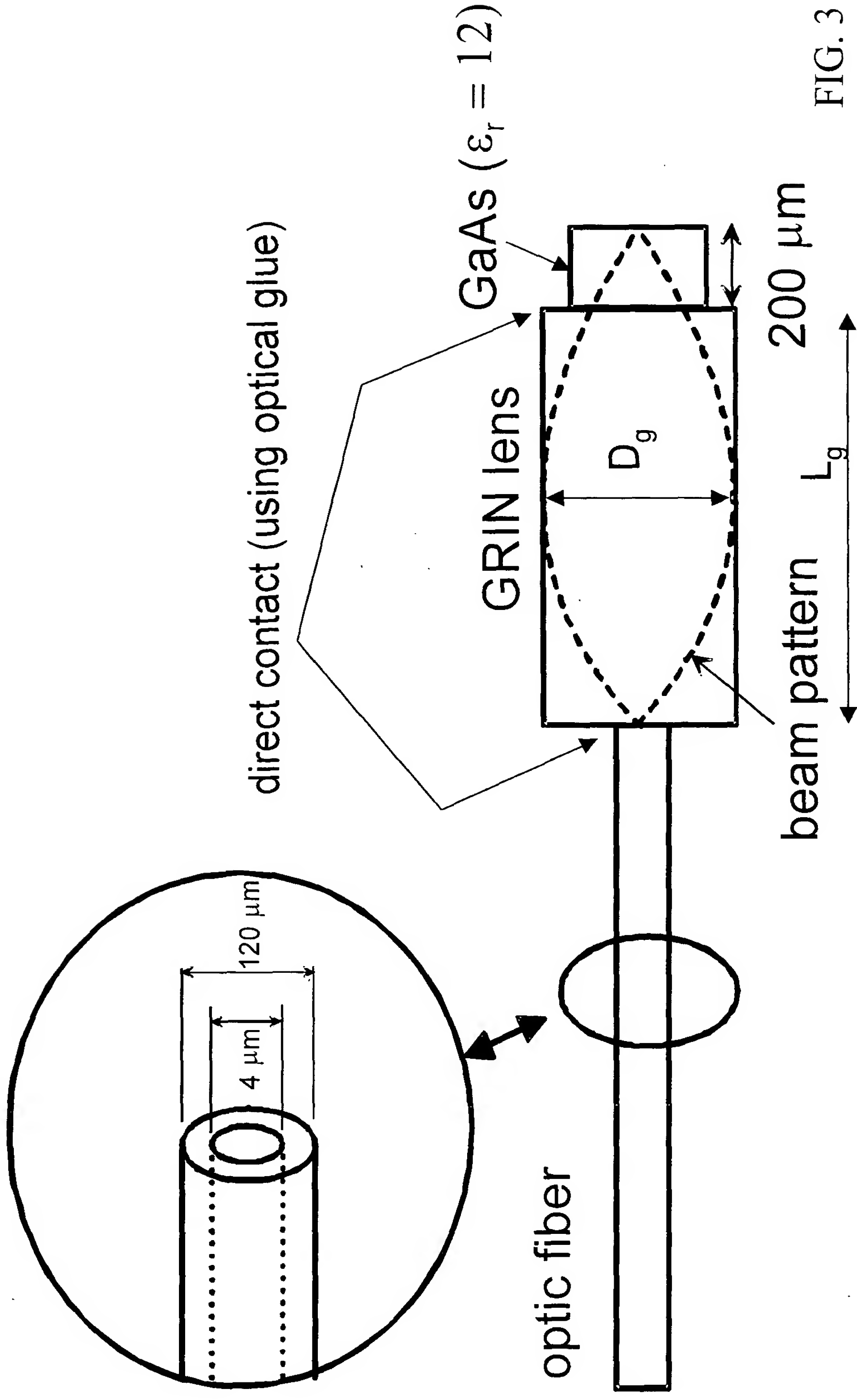


FIG. 3

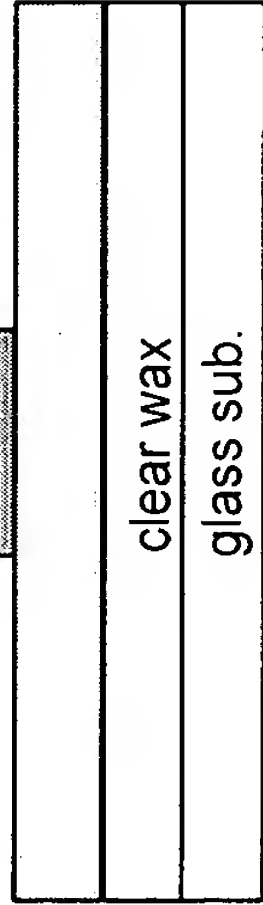
Fiber-Based Electro-Optic Sampling System
Probe Tip Fabrication Procedure



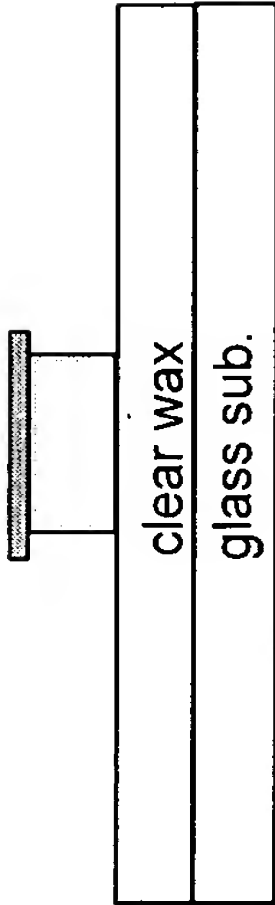
PR 1827 : 3.5 Krpm (30 sec), 105 C (1 min)



PR 1827 : expose (15 sec), develop (50 sec),
hard bake (105 C, 1 min)



mount sample on glass substrate
using clear wax (on the 150 C hot plate)



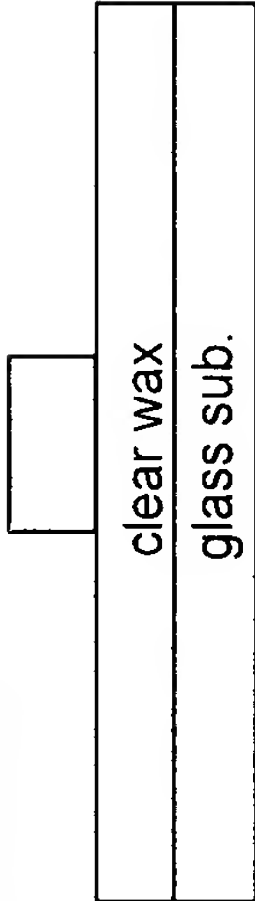
wet etching : $H_2SO_4 : H_2O_2 : H_2O$

= 1 : 8 : 1

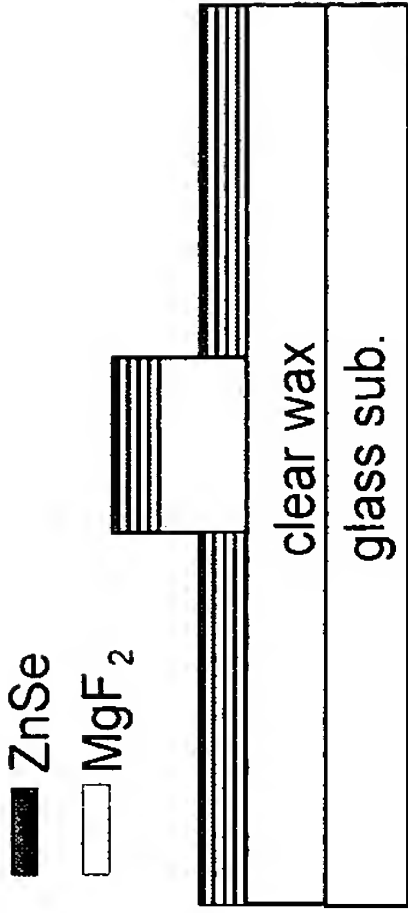
+ few drops of NH_4OH

agitate 30 sec every 30 sec

change etchant every 10 min.



expose without mask (15 sec), develop (90 sec)



Distributed Bragg Reflector (DBR) deposition

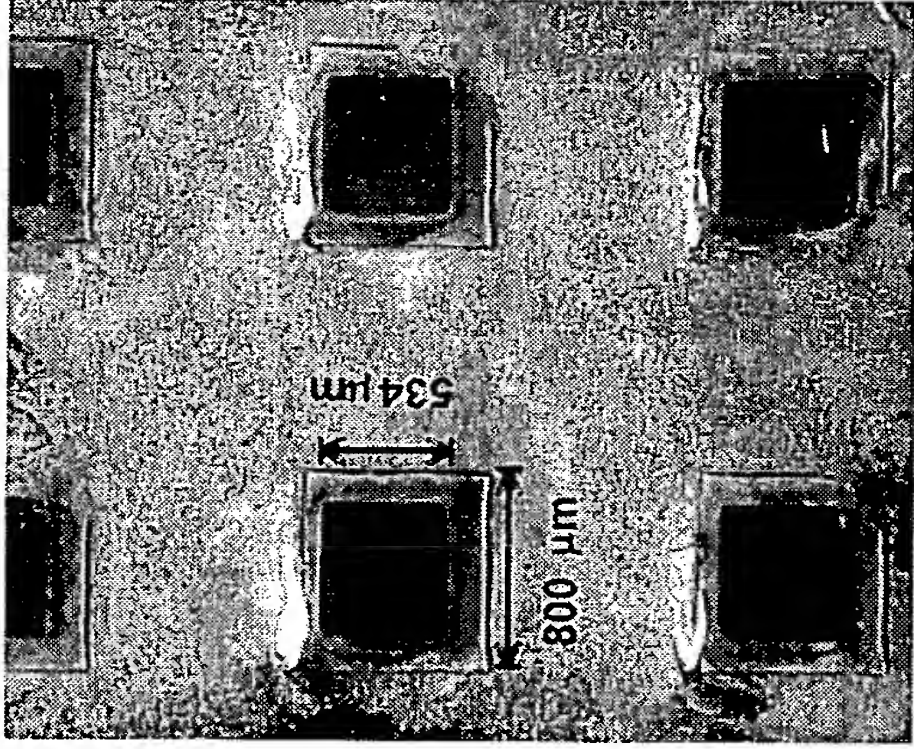
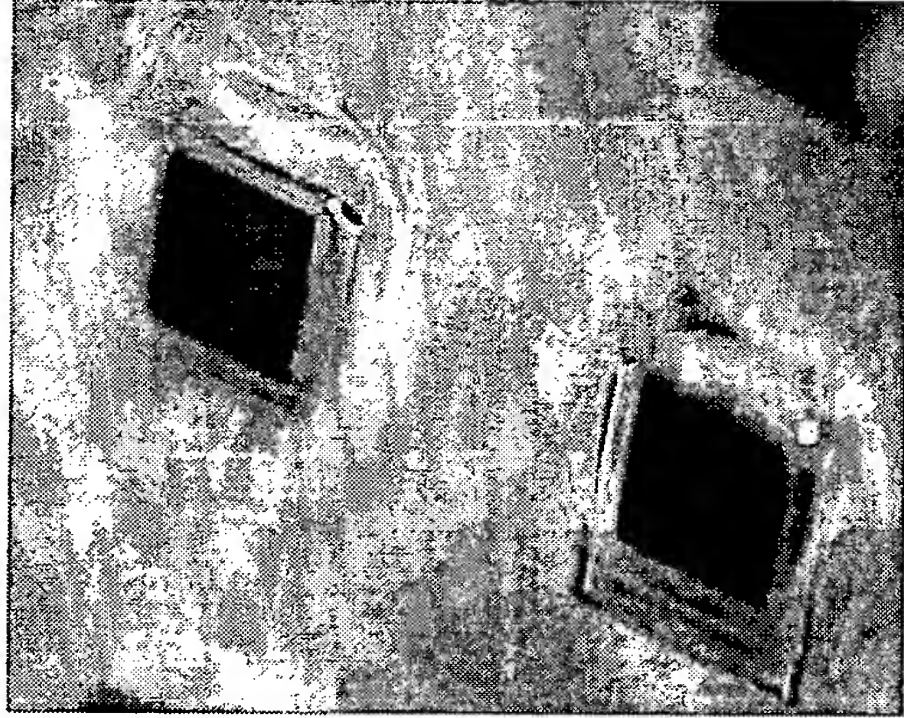
$MgF_2 = 1,403 \text{ \AA}$, $ZnSe = 833 \text{ \AA}$ x 4 sets



Final probe tip
(released in the hot acetone)

FIG. 4

Fiber-Based Electro-Optic Sampling System Probe Tip Fabrication - (100) GaAs



etching depth ~ 160 μm (7.95 μm/min x 20 min)
(lateral : 130~150 μm, 6.5~7.5 μm/min)

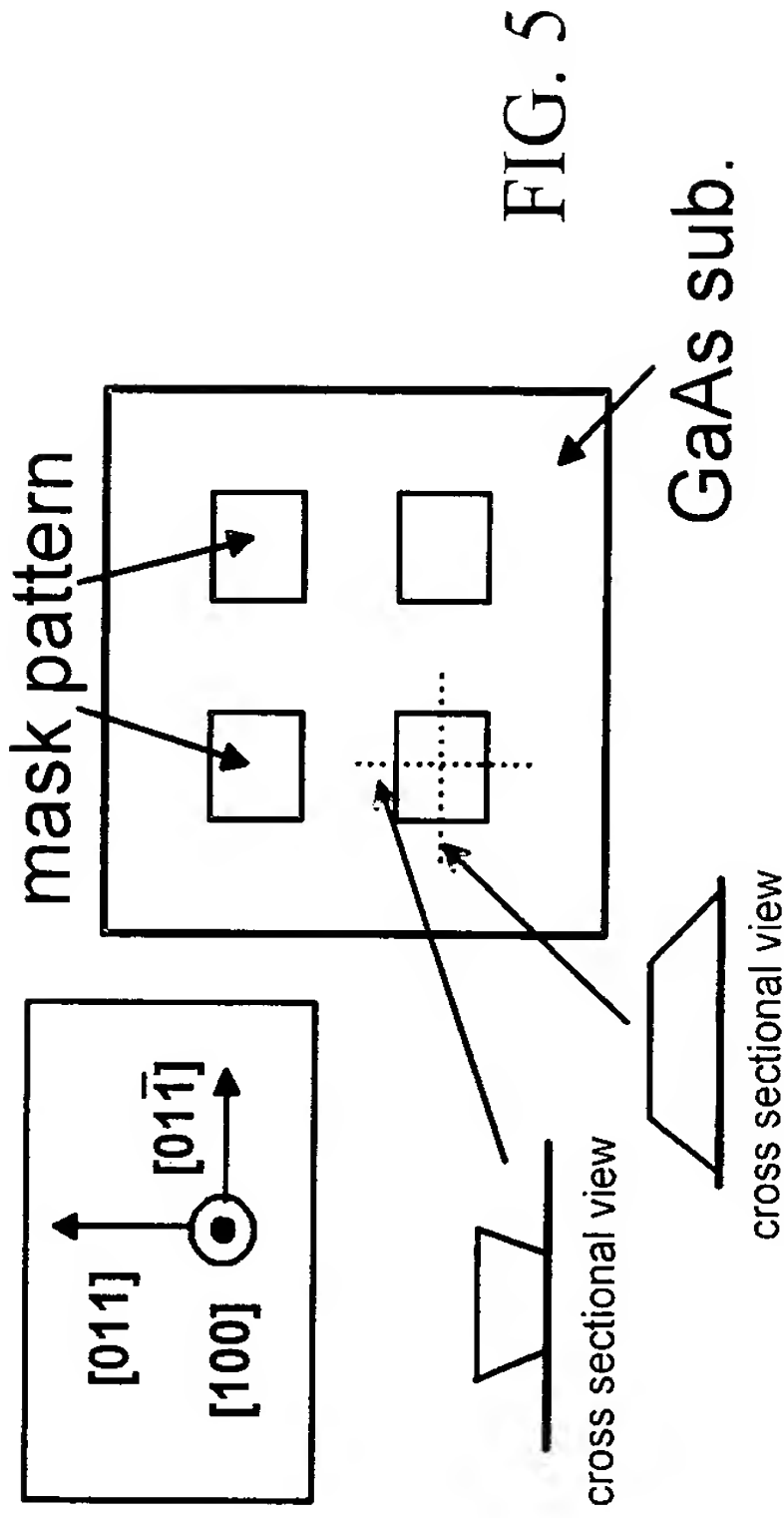
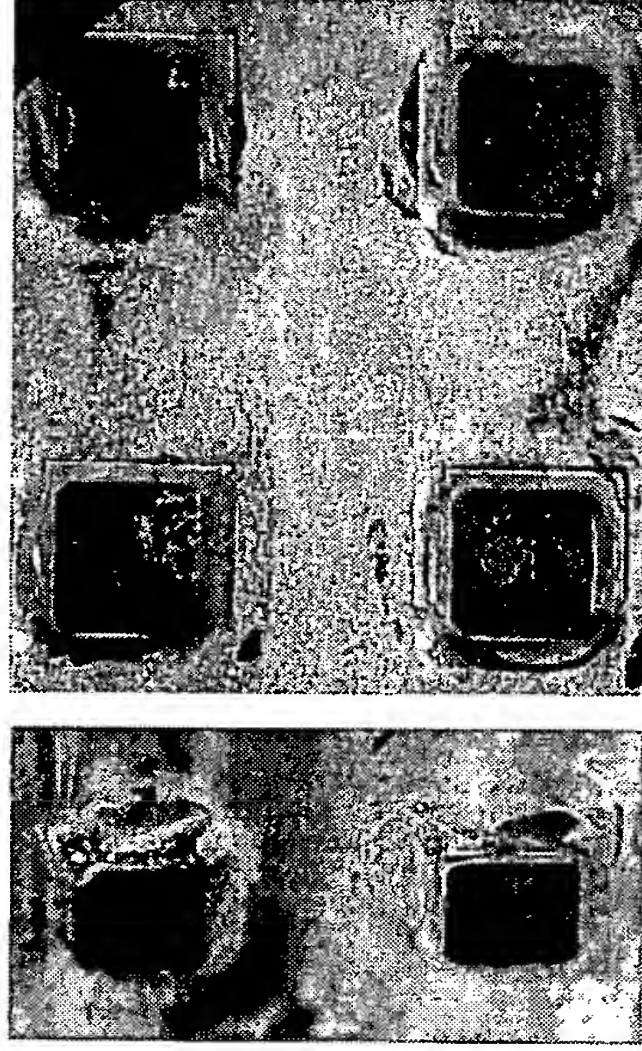
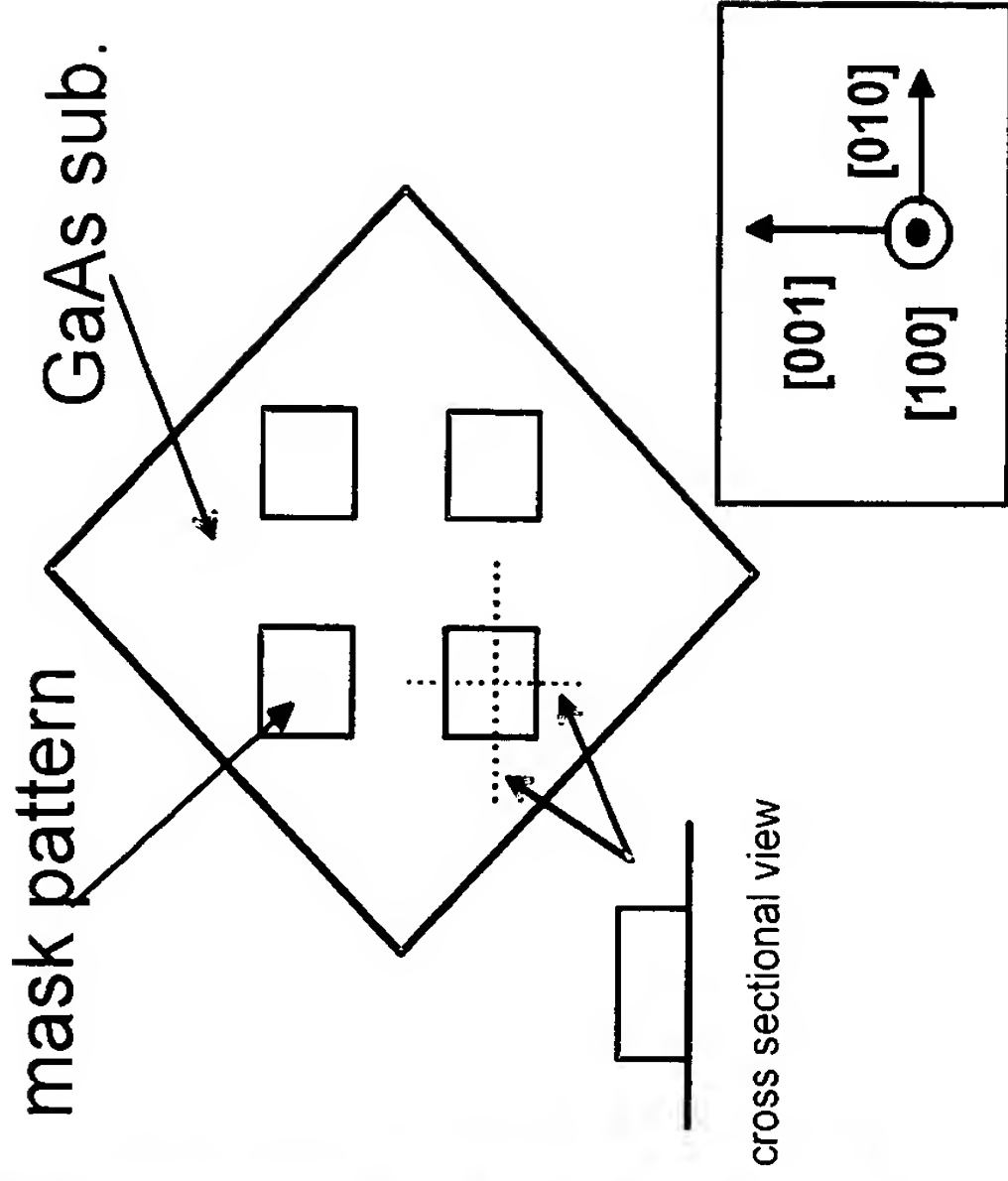


FIG. 5

Fiber-Based Electro-Optic Sampling System Probe Tip Fabrication - (110) GaAs

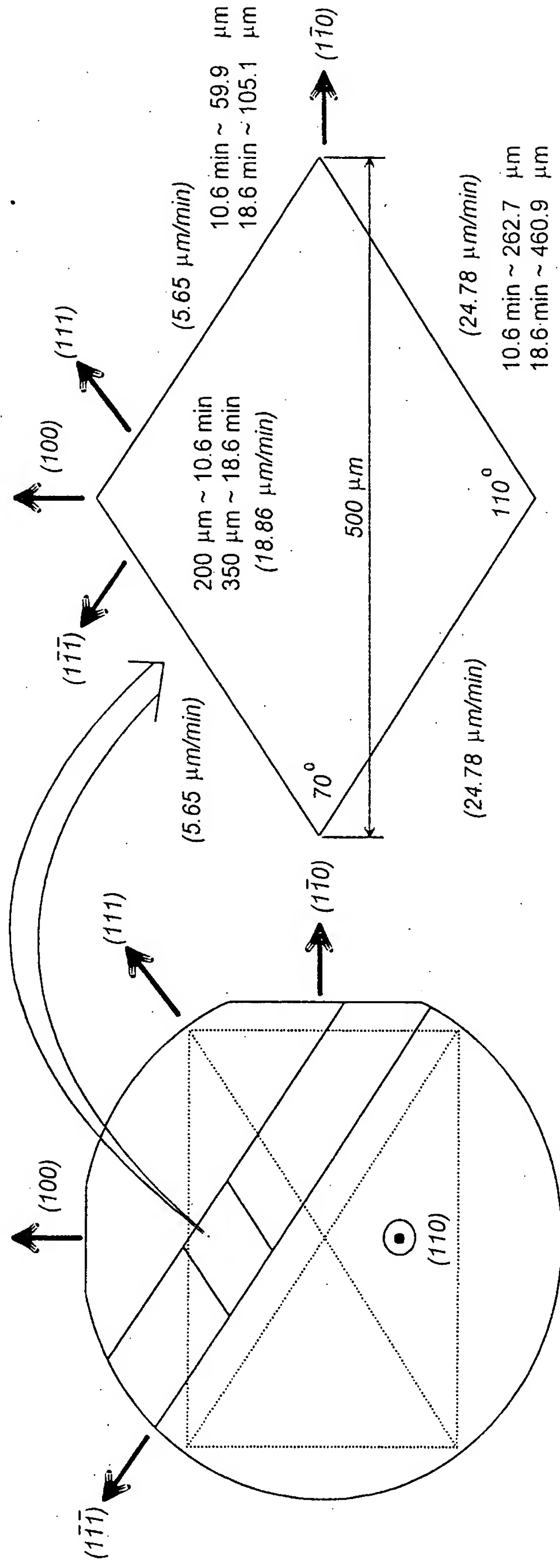
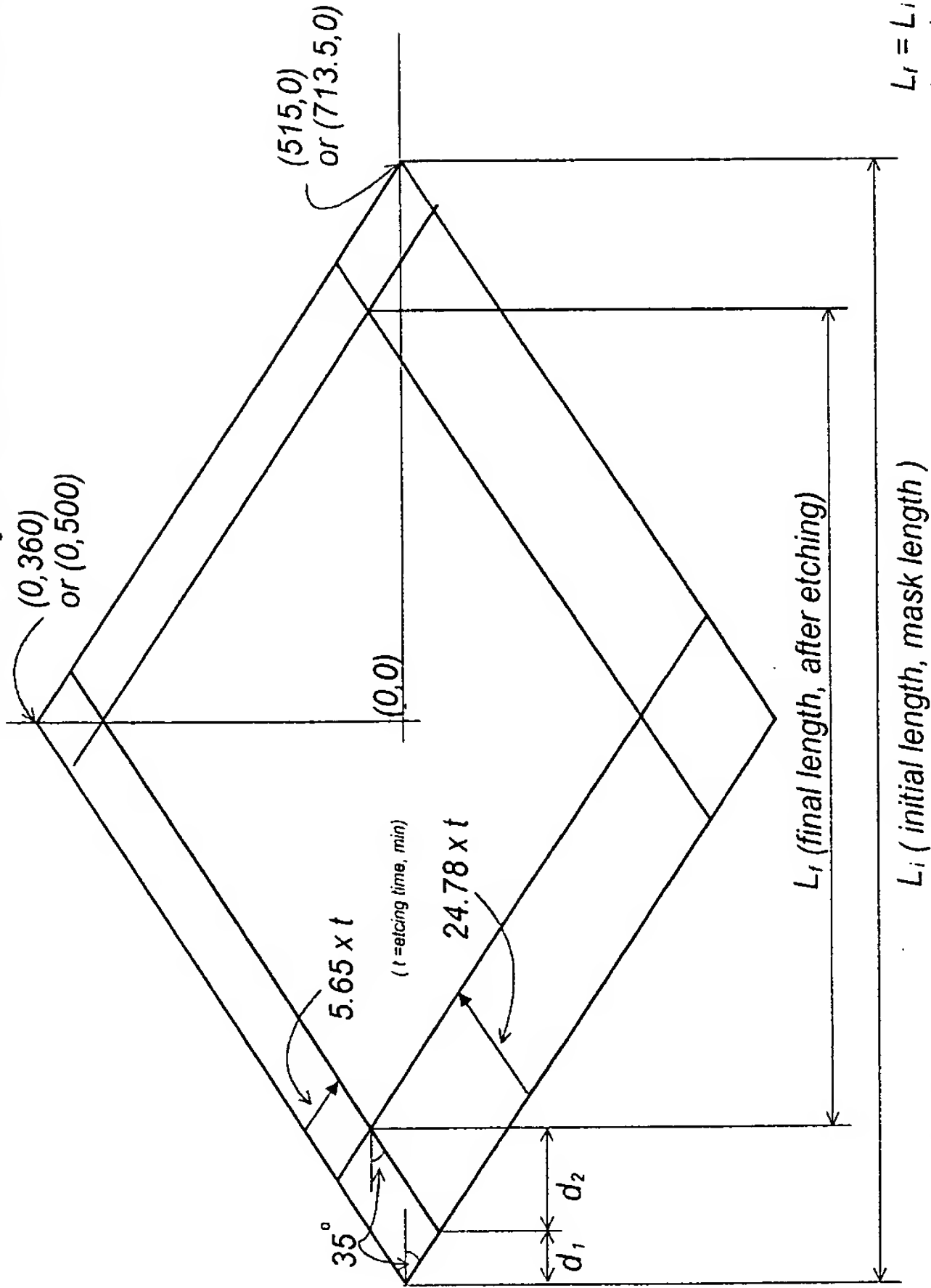


FIG. 6

Fiber-Based Electro-Optic Sampling System
Probe Tip Fabrication - (110) GaAs



goal : $L_f = 500 \mu m$

$$L_f = L_i - (d_1 + d_2) \times 2$$
$$L_f = L_i - [5.65 \times t \times \cos(35^\circ) + 24.78 \times t \times \sin(55^\circ)] \times 2 = 500$$
$$L_i = 500 + [5.65 \times \cos(35^\circ) + 24.78 \times \sin(55^\circ)] \times 2 \times t$$

where,
 $t = 200 / 18.86 (\mu m/min) = 10.6 \text{ min}$ for 200 μm wafer
 $t = 350 / 18.86 (\mu m/min) = 18.6 \text{ min}$ for 350 μm wafer
(t = etching time, min)

▲ $L_i = 1029 \mu m$ for 200 μm wafer,
= 1427 μm for 350 μm wafer

FIG. 7

Fiber-Based Electro-Optic Sampling System Probe Head Assembly

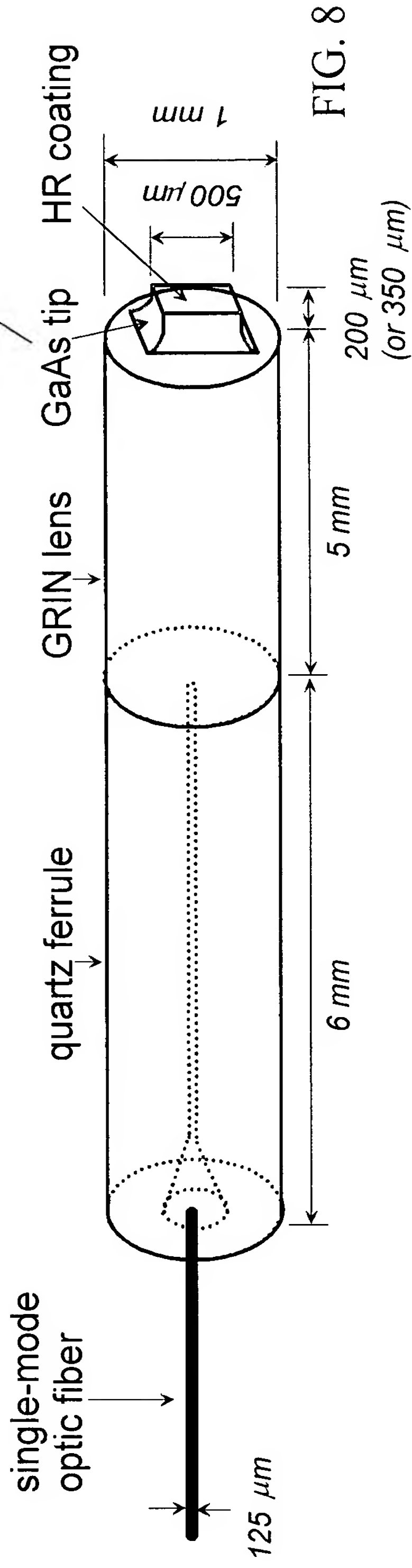


FIG. 8

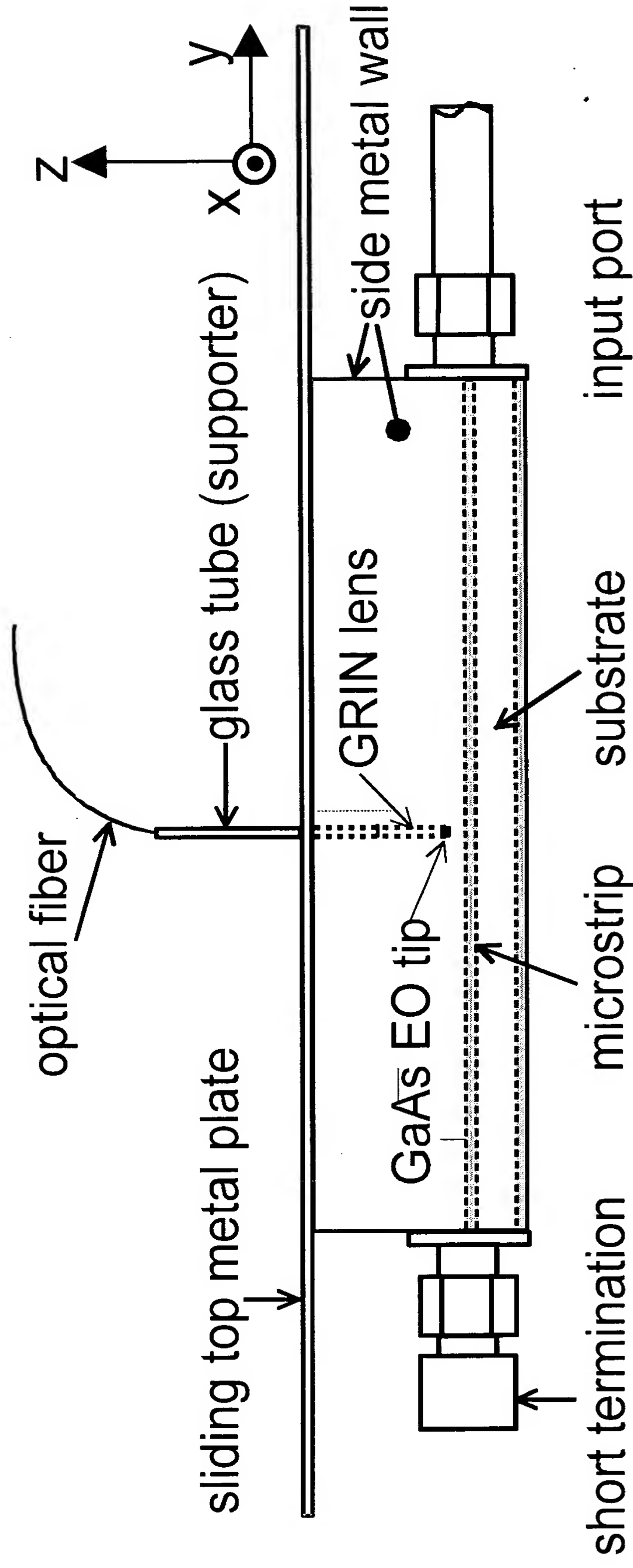


FIG. 9

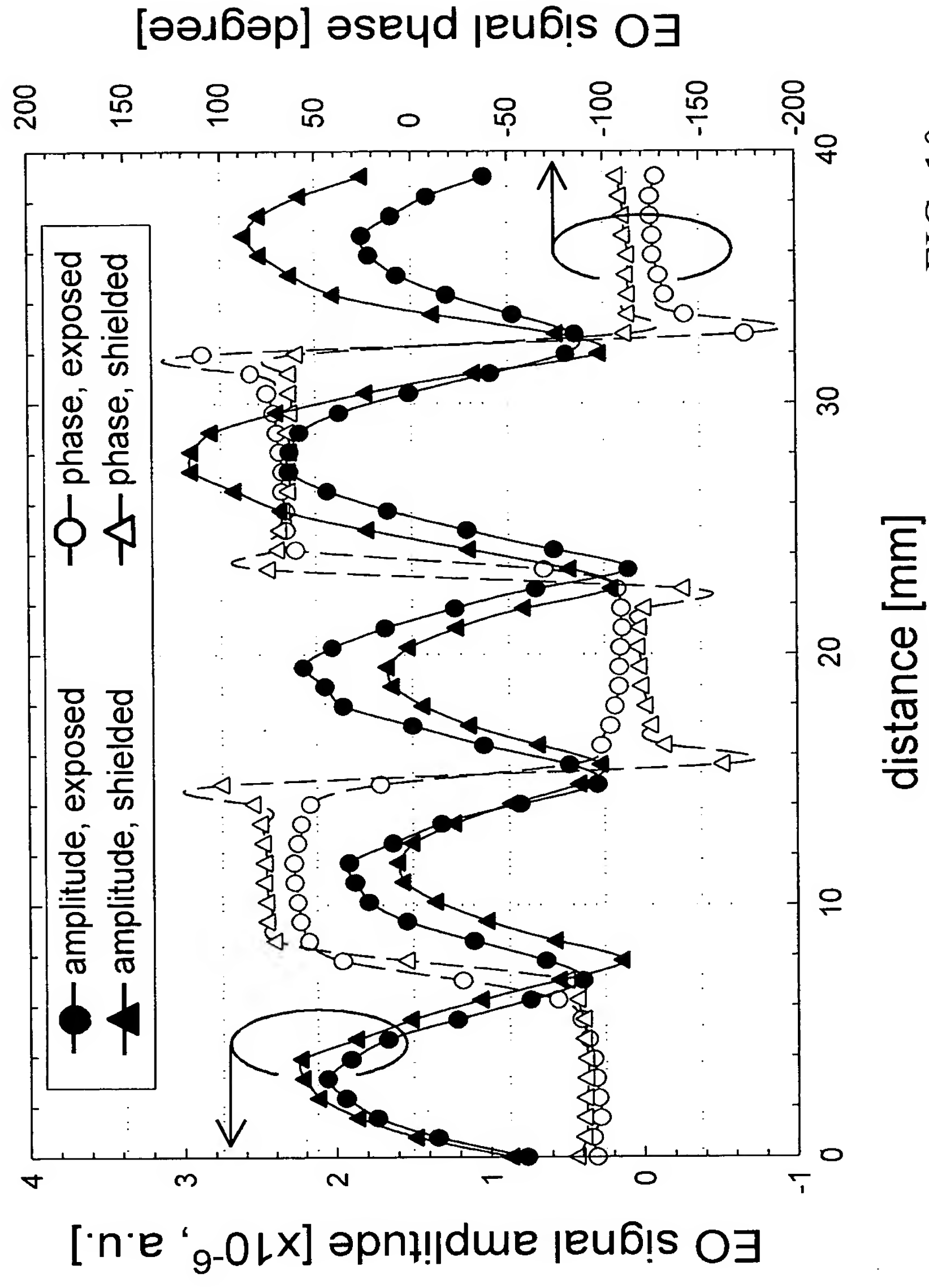


FIG. 10

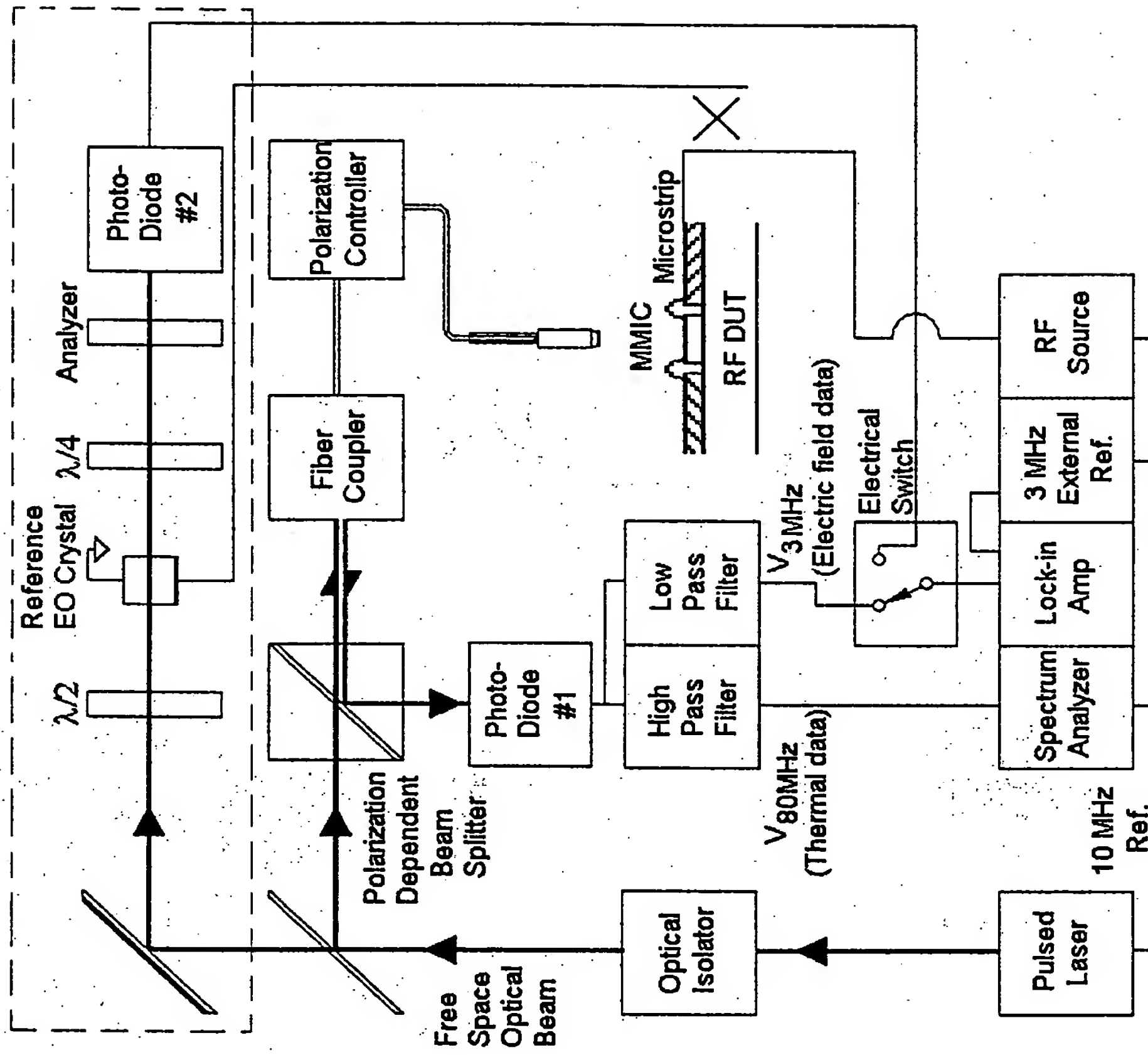


Fig 11

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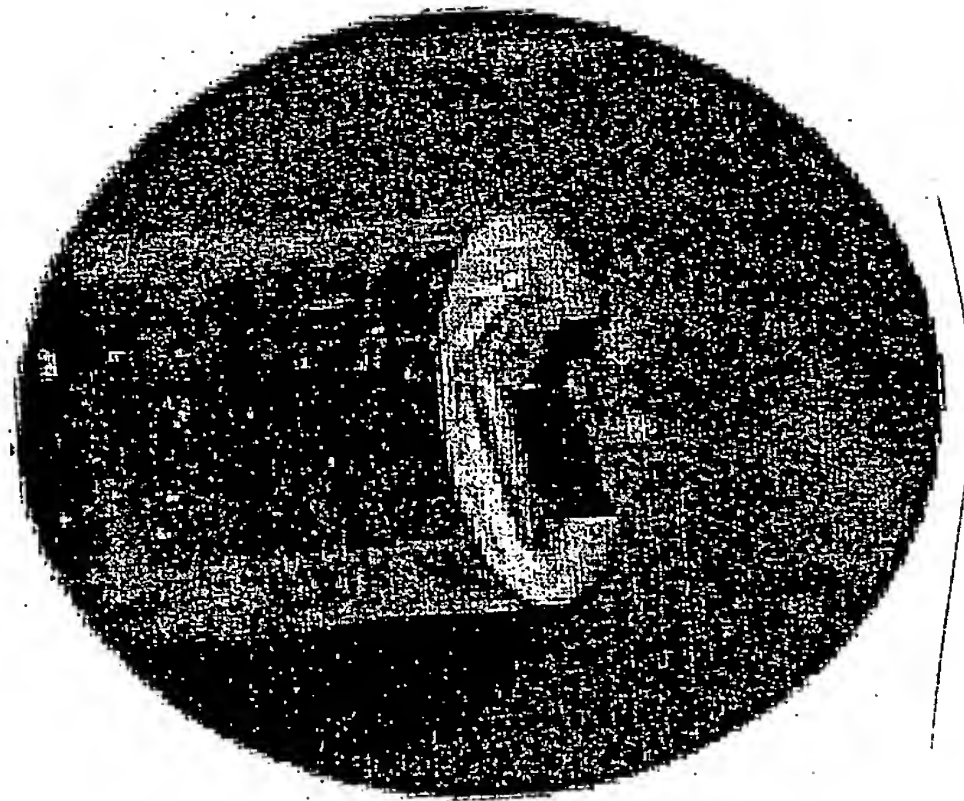


Fig 12

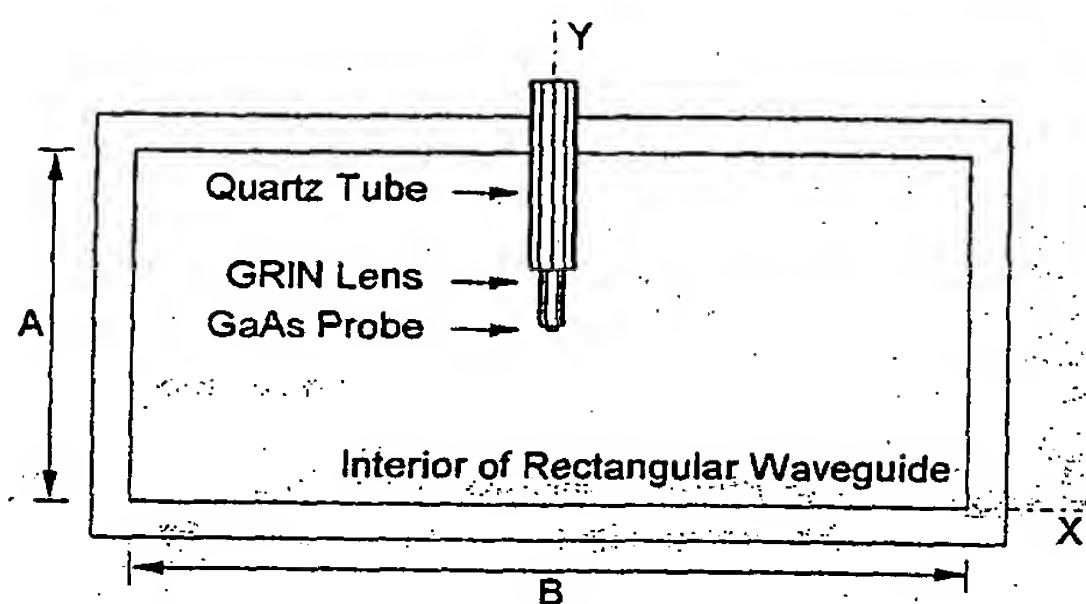


FIG 13

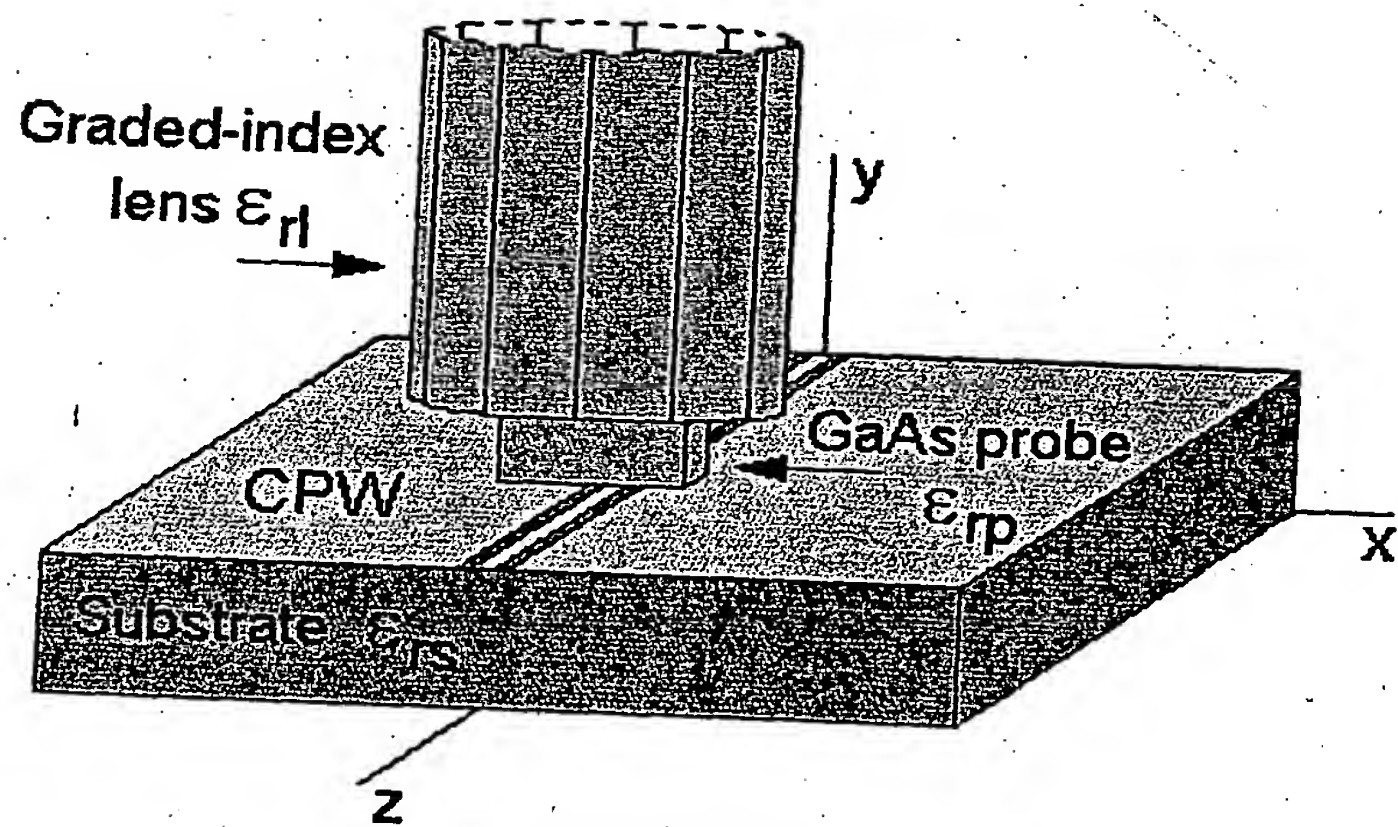
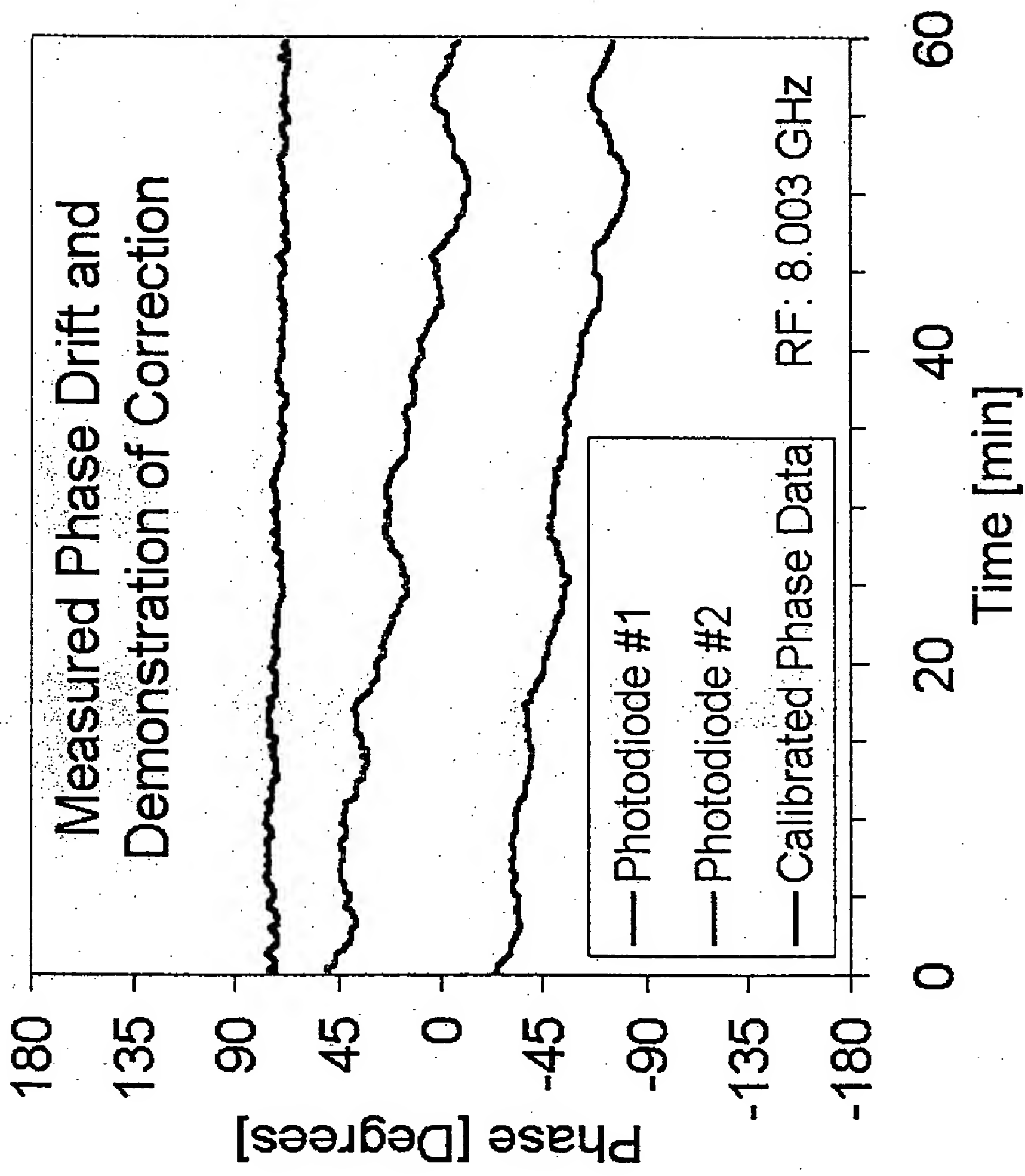


FIG 14

Characterization - Electric Field Phase



•Over one hour, measured temporal phase stability is $\pm 3^\circ$.

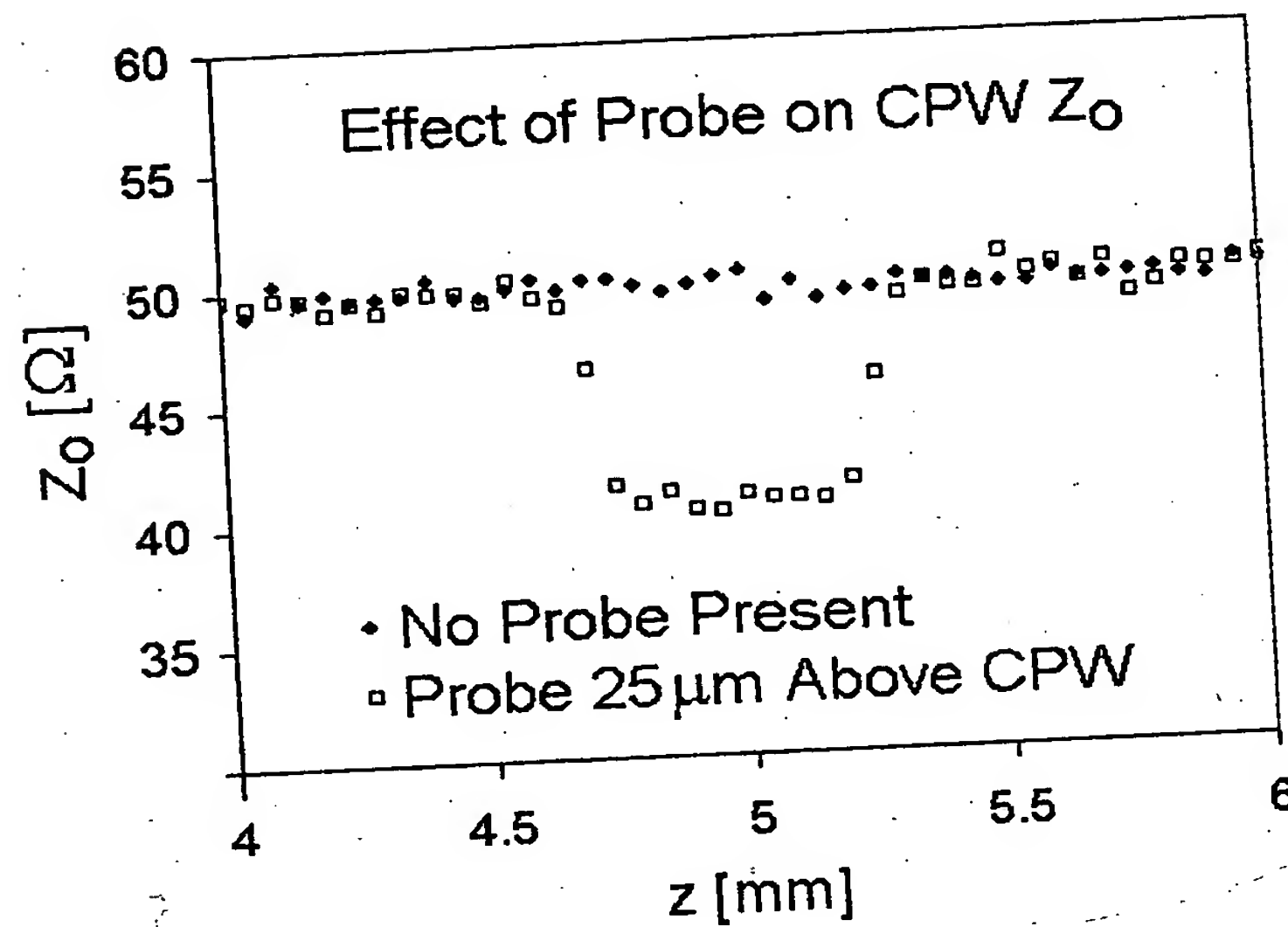
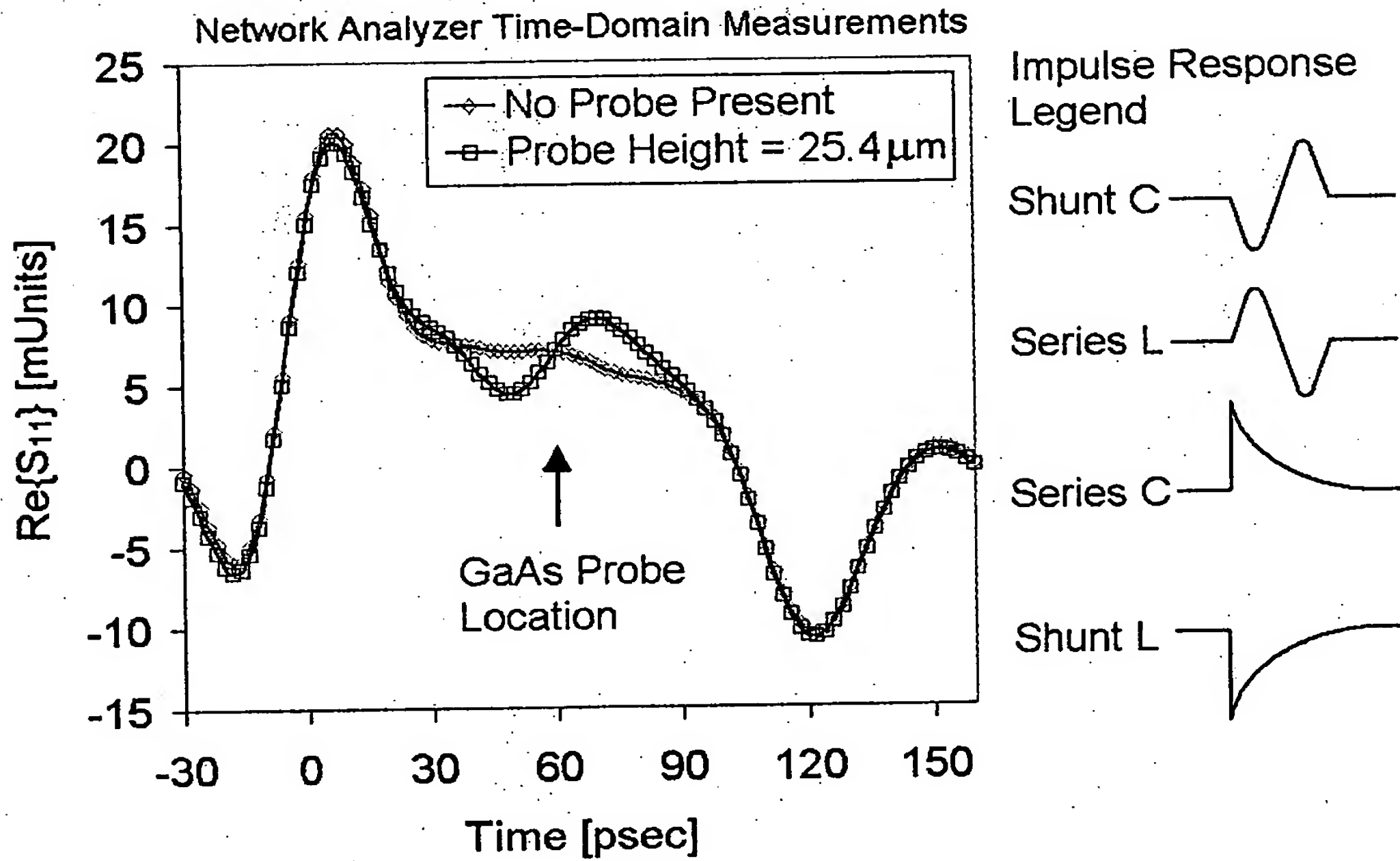


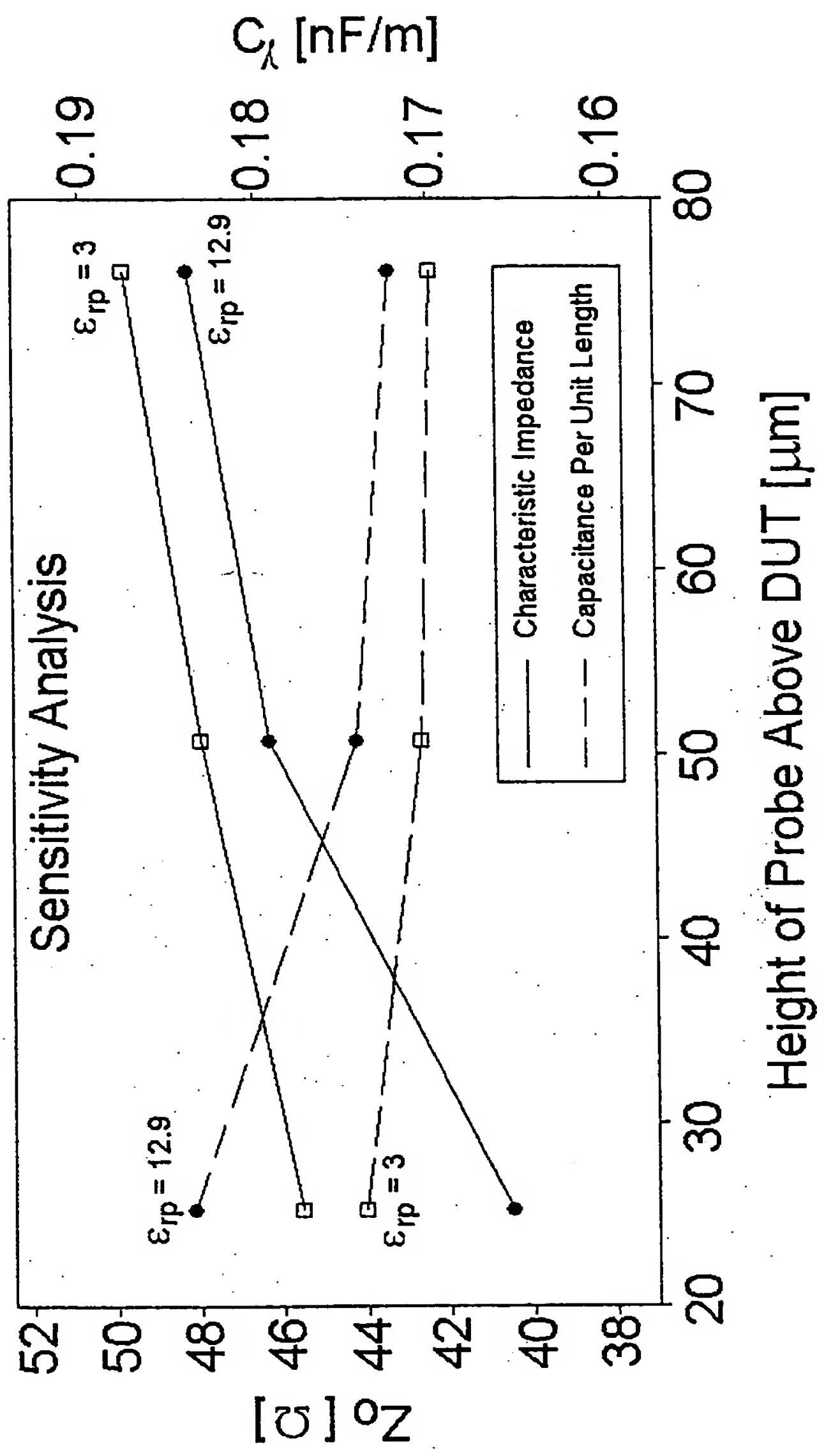
FIG 16



Frequency domain measurements (2 - 40 GHz):
 $|S_{11}| < -30$ dB with and without probe.

FIG 17

Sensitivity Analysis



•Effect of probe is equivalent to a lumped shunt capacitance on the order of femtofarads.

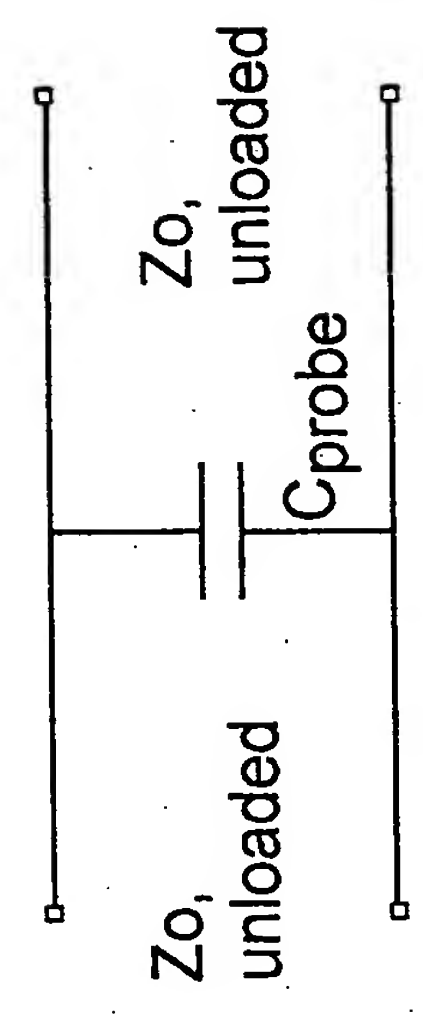


Fig 18

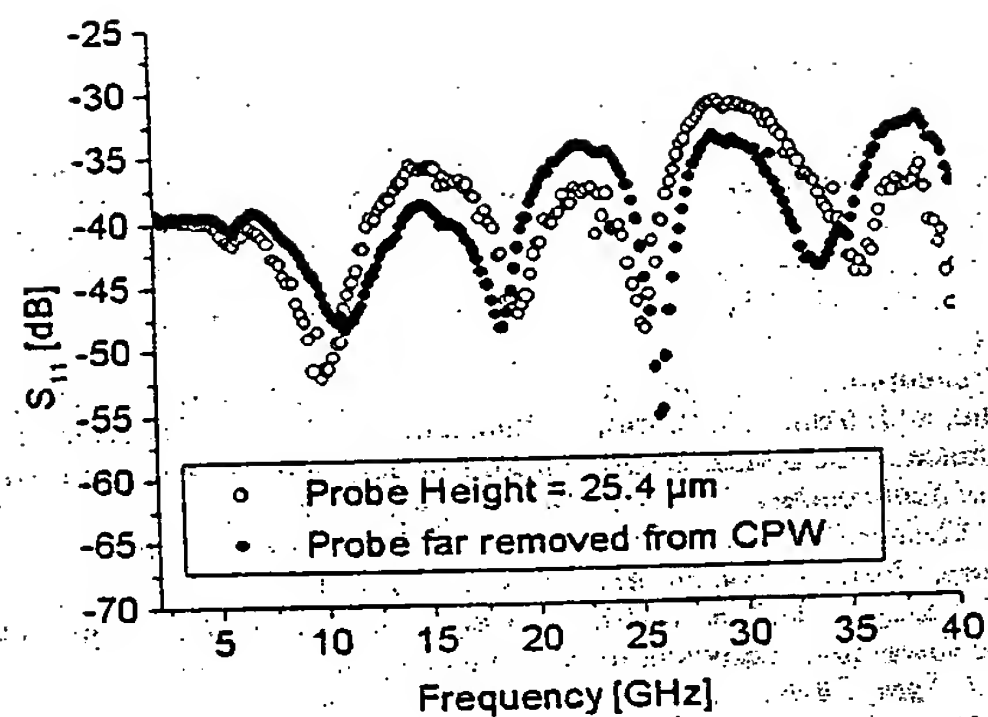


FIG 19

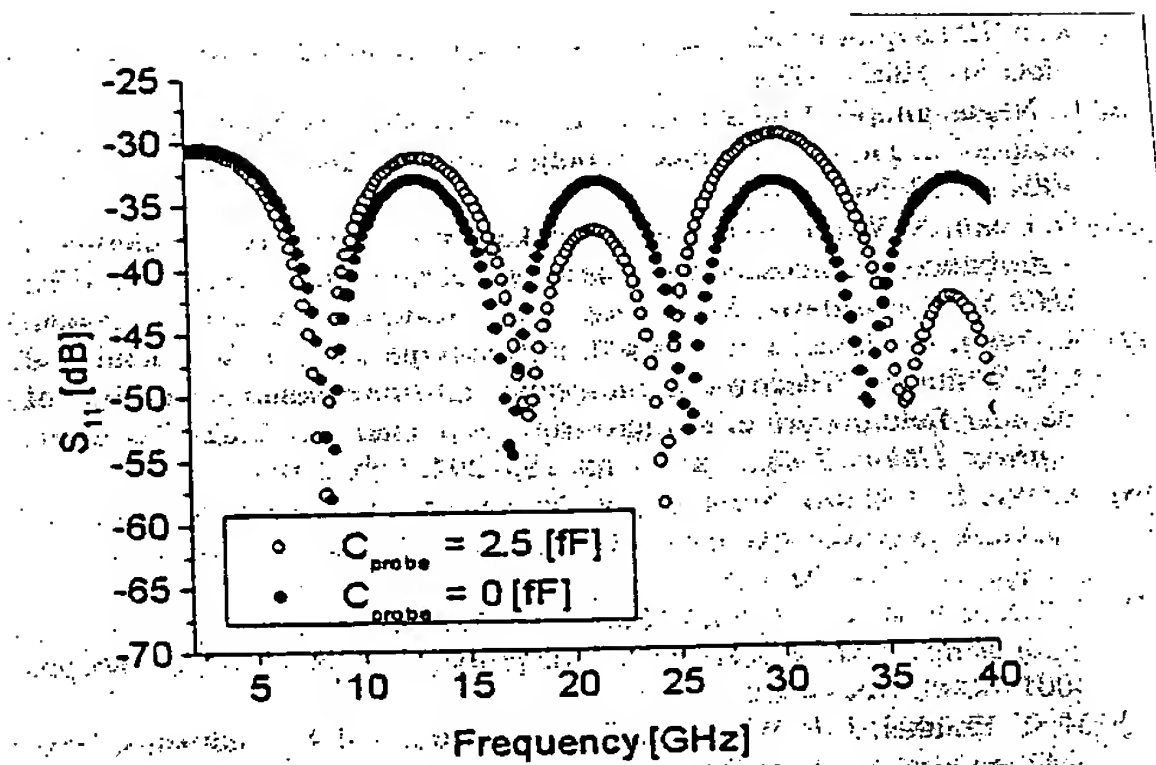


FIG 20

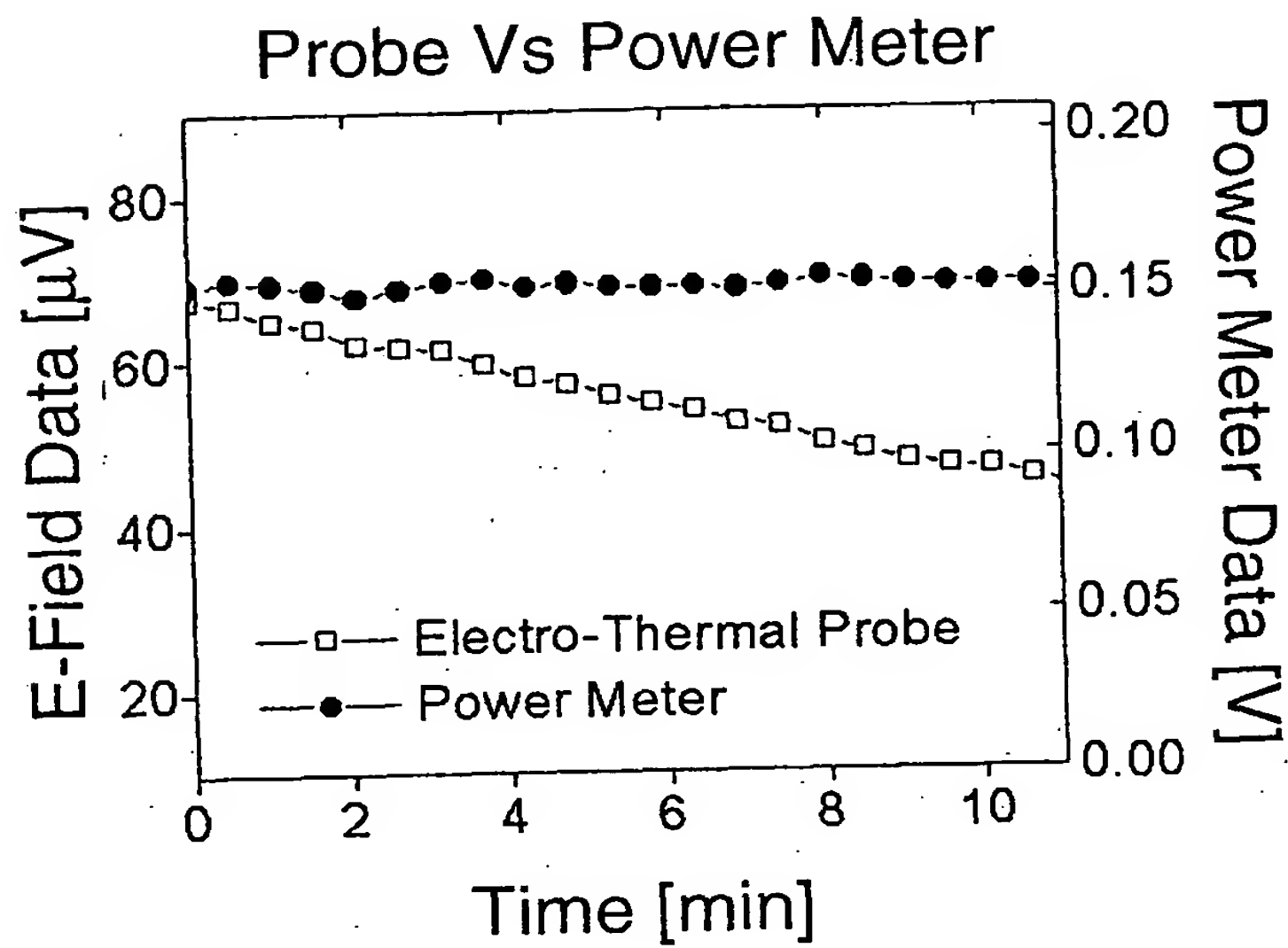


FIG 21

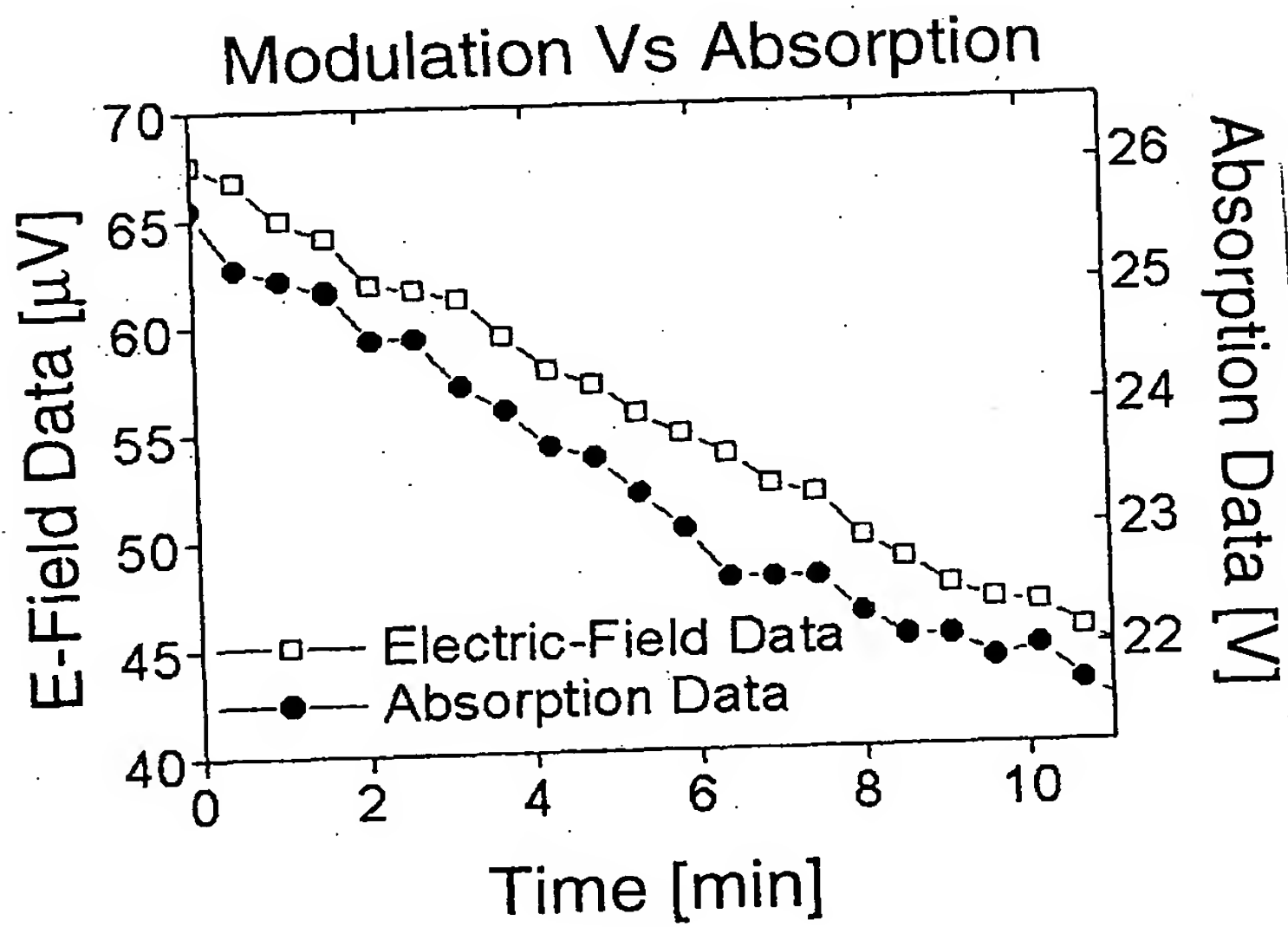


FIG 22

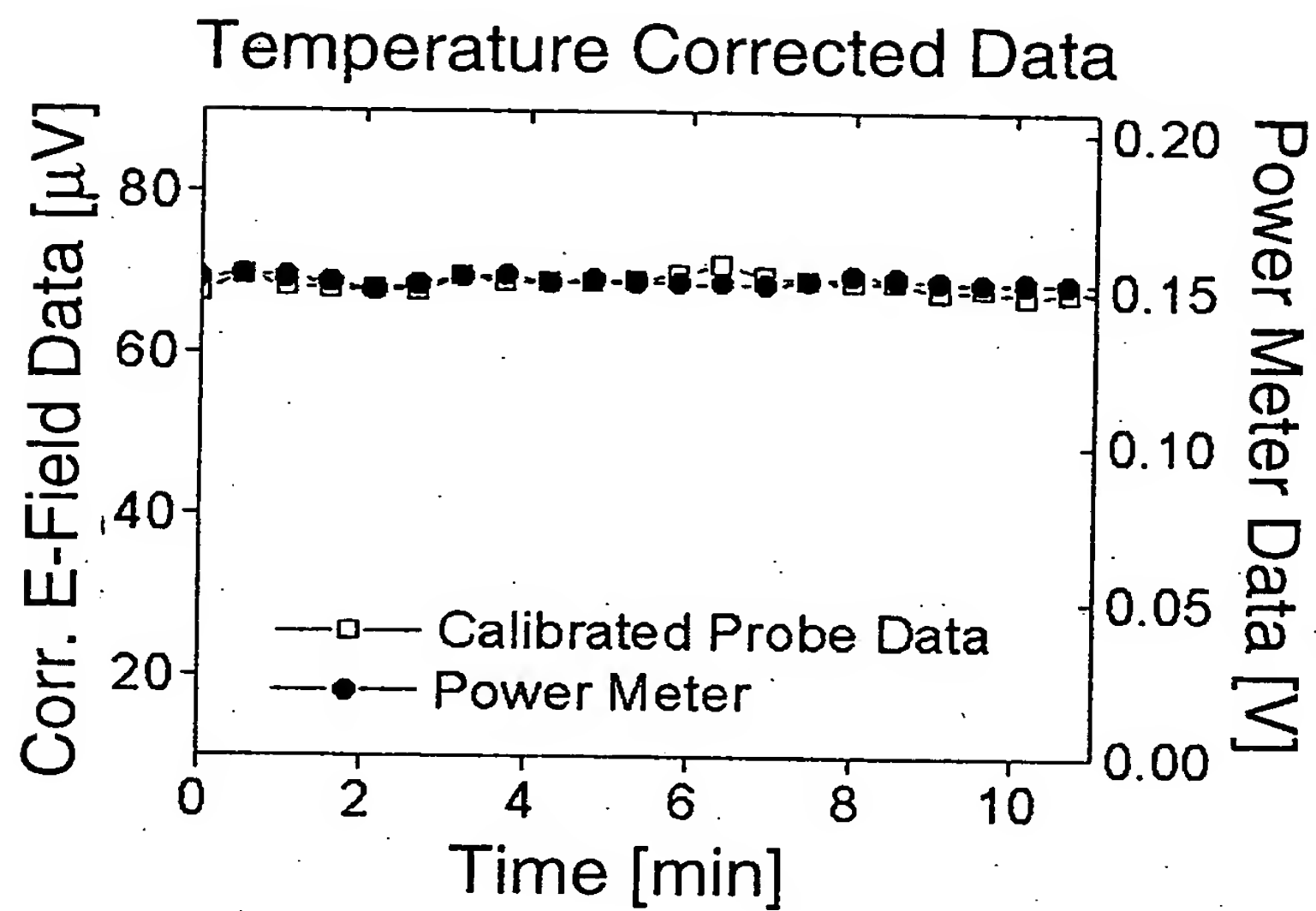


FIG 23

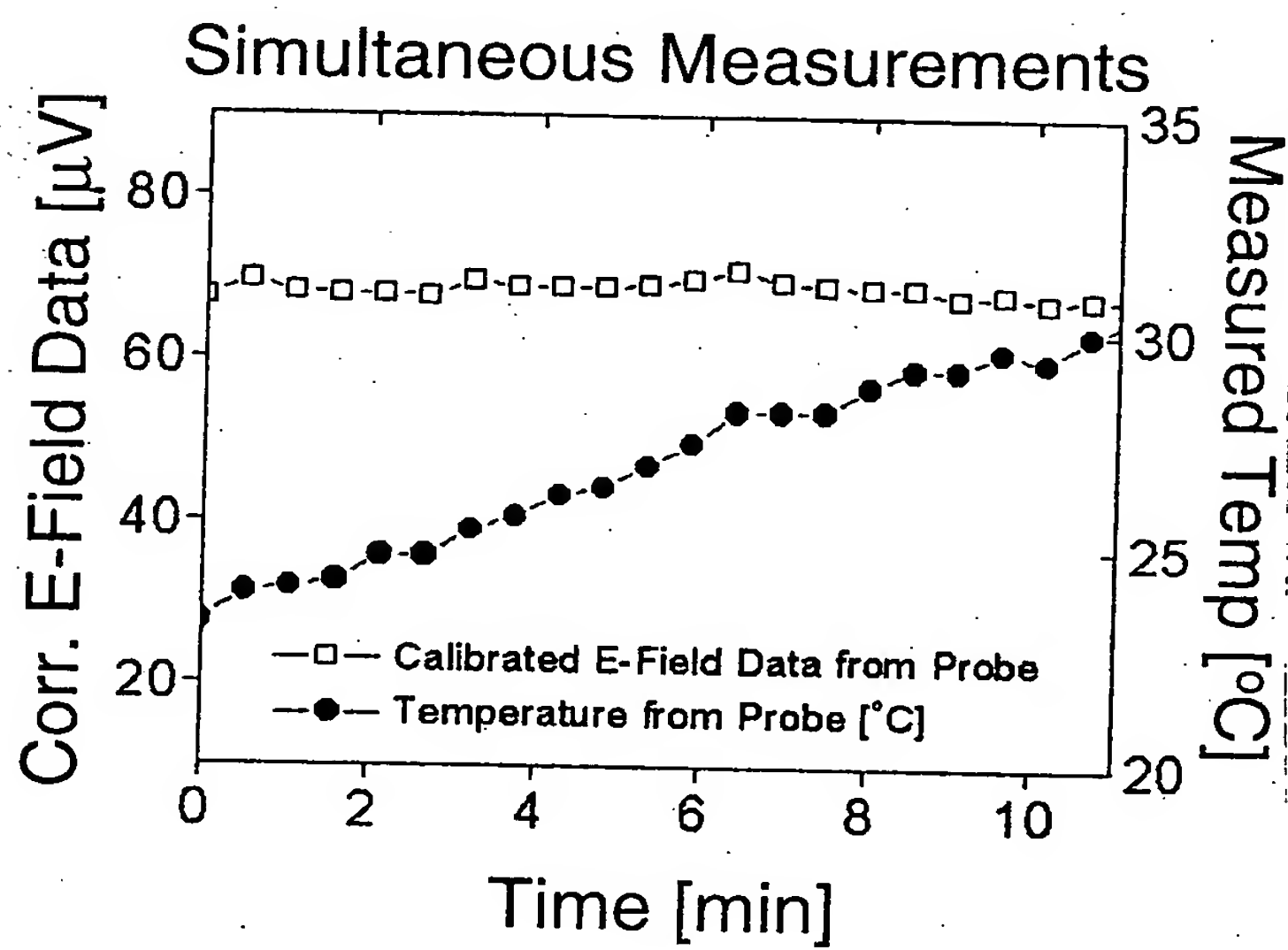


FIG 24